System Engineering and Technical Authority

Execution Proposal

To SEA Enterprise BOD

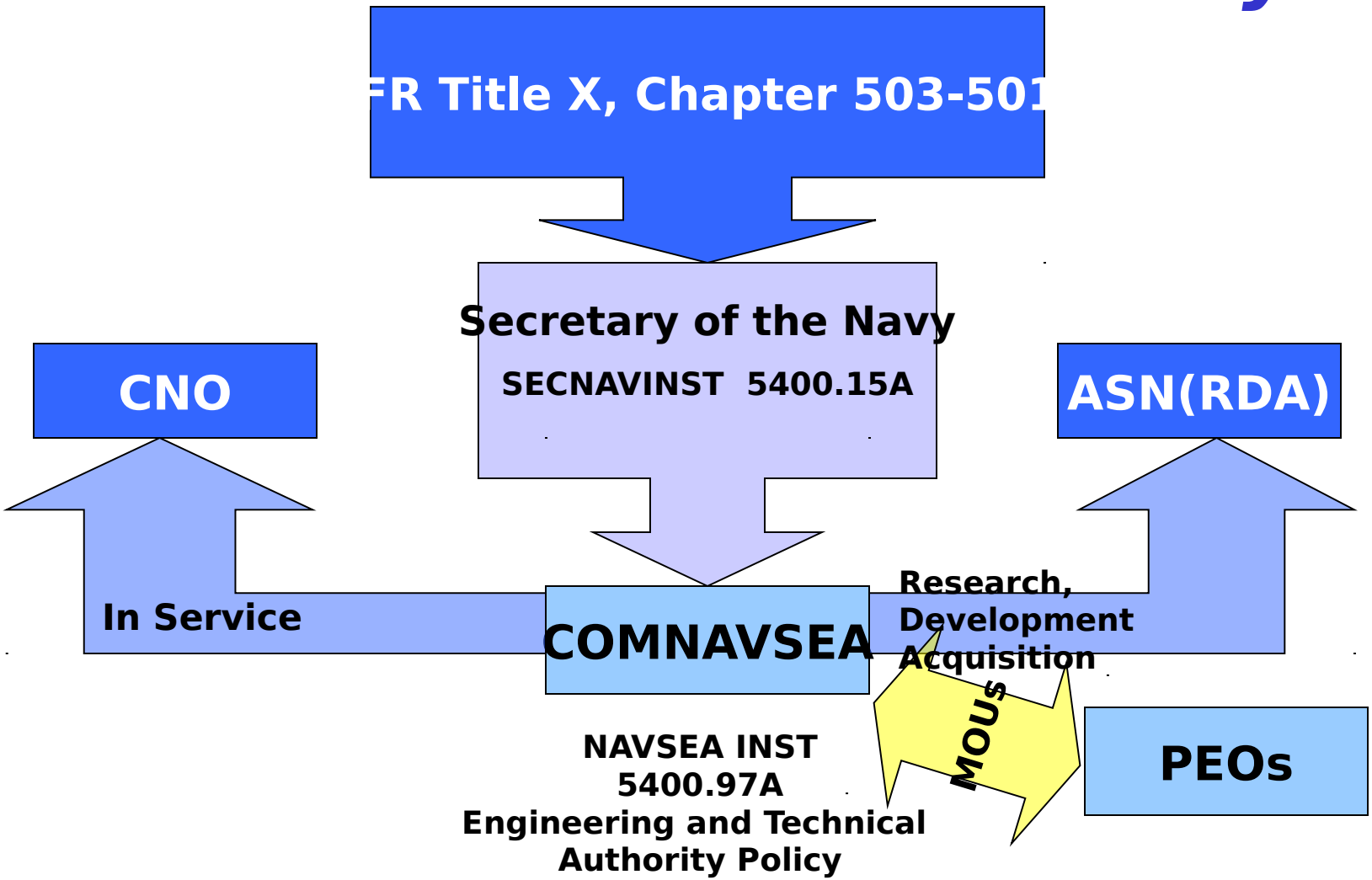
27 May 2004

Round Two: Deliverables

- Technical Authority Process and Needs
- Workload Increase
- Resources
- Support Program Authority
- Process - Today / Tomorrow
- POM Process - Today / Tomorrow

Answer the Mail: Provide Process and Options

We Have A Legal Requirement to Execute Technical Authority



Roadmap: Technical Authority and Systems Engineering

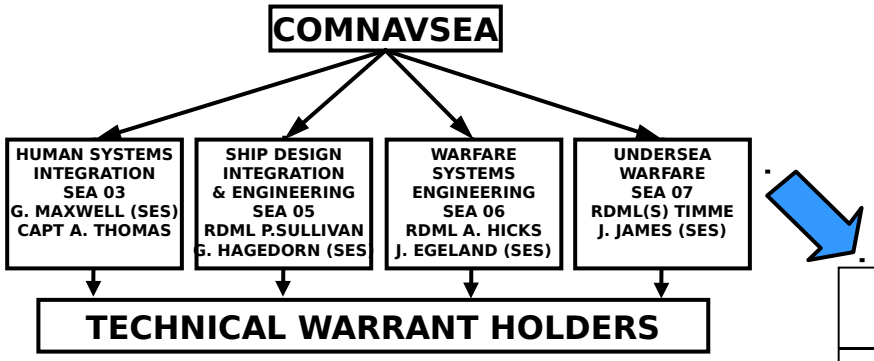
Resource Sponsor Breakout	N43	N61	N75	N76	N77	N78	N70
Human Systems Integration							
Certification							
Future Fleet Capabilities							
Mission Capability Systems Engineering							
Embeded Interoperability Engineering							
In-Service Submarine Systems Engineering							

PEO Breakout	AIR	C4I	CV	IWS	LMW	SHIP	SUBS
Human Systems Integration							
Certification							
Future Fleet Capabilities							
Mission Capability Systems Engineering							
Embeded Interoperability Engineering							
In-Service Submarine Systems Engineering							

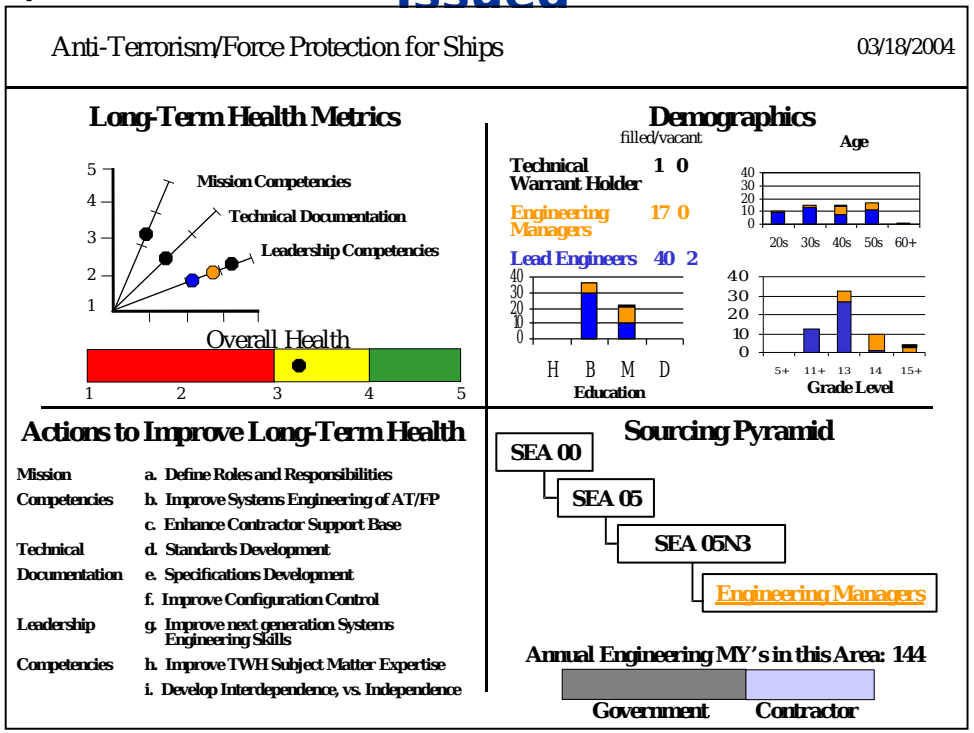
Requires a Corporate Focus and a Corporate Solution

How We Are Executing Technical Authority

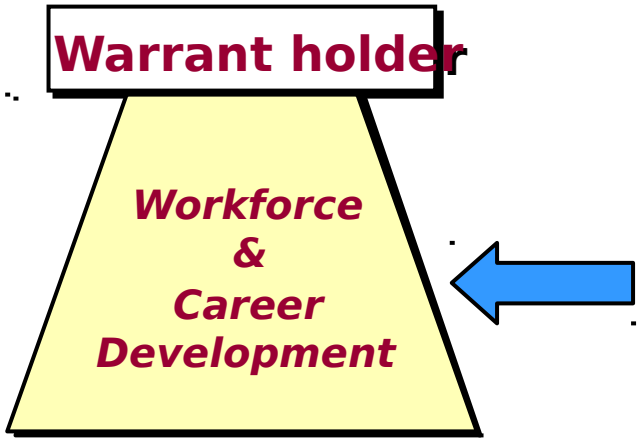
Phase I: Policy instructions Issued


COMNAVSEA
HUMAN SYSTEMS INTEGRATION SEA 03 G. MAXWELL (SES) CAPT A. THOMAS
SHIP DESIGN INTEGRATION & ENGINEERING SEA 05 RDML P.SULLIVAN G. HAGEDORN (SES
WARFARE SYSTEMS ENGINEERING SEA 06 RDML A. HICKS J. EGELAND (SES)
UNDERSEA WARFARE SEA 07 RDML(S) TIMME J. JAMES (SES)
TECHNICAL WARRANT HOLDERS

Phase II: 156 Warrants Issued



Phase III



Impact On Safety

Technical Authority

USS DOLPHIN

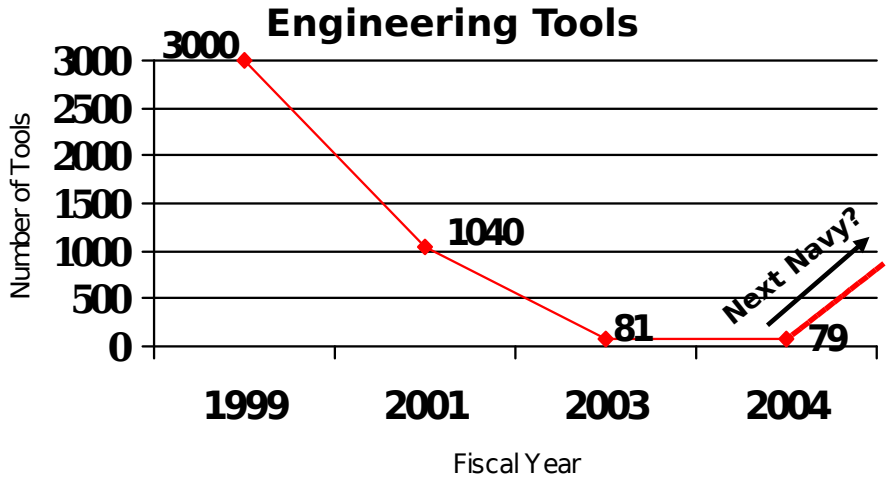
We were approximately 1½ minutes from losing ship.

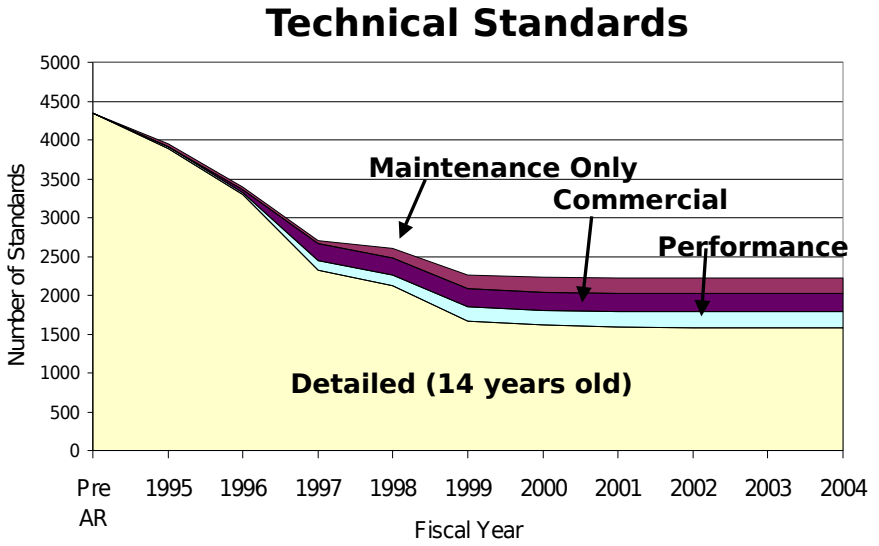
- **Root causes**
  - **no clear technical authority**
  - **complacent technical work f**
  - **insufficient resources to wat**

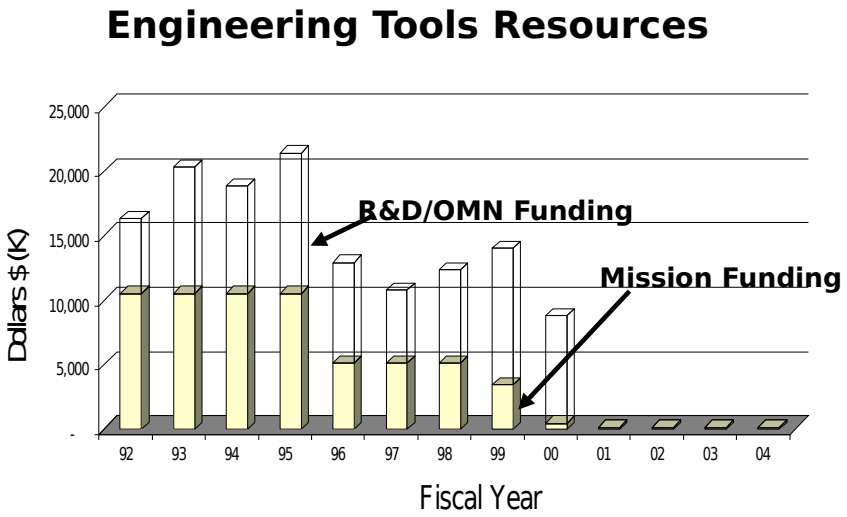
Loss of Independence

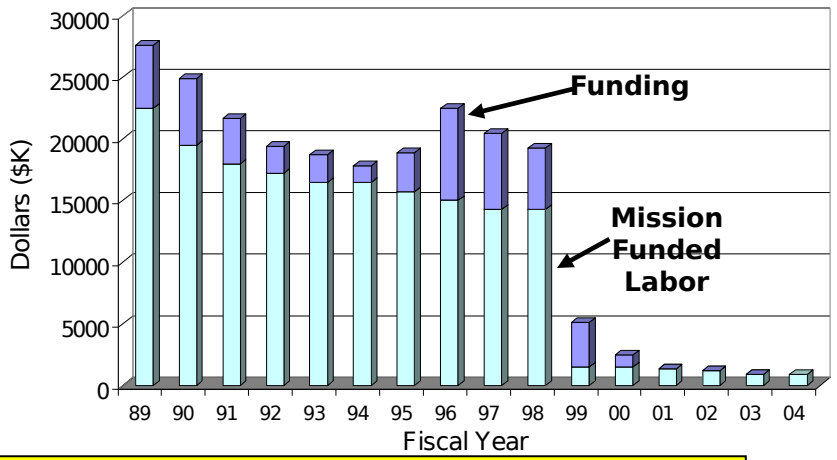
Cost of 1 Engineer = $180K per year
st to Fix DOLPHIN = $22.8M; HUGE Negative RO
Cost of Submarine = Priceless

Declining Resources – Obsolete Standards and Tools









Fleet, New Construction, and INSURV All Depend on Us to Keep This Body of Knowledge Current

Workload Ahead

- Current Navy
- Next Navy
- Navy After Next

Current Navy

Last 10 Years	Next 10 Years
• *320-350 Ships*	• *Less than 300 Ships – Fail to sail impact of machinery problem increase*
• *"Predictable" Deployment Departures; generally 6 months*	• *FRP – Surging Navy* • *Sea Swap*
• *D-30 Process*	• *FRP C5I Message* • *FRP C5I HSI Certification*
• *MIL-SPEC & COTS Computing Systems*	• *COTS & Open Architecture*
• *Predictable CNO maintenance schedule and*	• *FRP / SHIPMAIN / SUBEMOD* • *Challenge every Technical and Maintenance Requirement* • *Stretch Overhaul Periodicity – "Sharpen Your Pencils"*
• *Standard Training Interface, little HSI*	• *SEAWARRIOR Alignment* • *FRP C5I HSI Certification* • *Optimal Manning Experiment Implementation*
• *2-3 Submarine Overhauls / Certs per year*	• *5-7 Submarine Overhauls / Certs per year*

Sweeping Changes Require Increased Technical Effort

Next Navy

Last 10 Years

- *Build Out*
  - *DDG 51*
  - *LPD 17*
  - *VIRGINIA*
  - *TAKR*
  - *CVN 68*
- *Software Development Millions SLOC*
- *Unspecified Interoperability Requirement for Combat System Development*
- *Stove-piped Acquisition*
- *Negligible Distributed Systems Refinement*
- *No HSI Policy*
- *AEGIS / Mil-Spec combat systems*

Next 10 Years

- *CVN 21 – The largest ship design ever attempted – 35M hours*
- *29 Ship Design and Construction Projects (hyperlink)*
- *New Hull Forms – LCS / DDX*
- *Software Development 10X Millions SLOC*
- *Interoperability Requirements Documented and Tested*
- *Mission Capability Based Acquisition*
- *Electric Warship*
- *Electromagnetic Launchers*
- *Optimal Manning Certification*
- *SEA SWAP / Alternate Crewing*
- *Human Performance Metrics / Test Procedures*
- *SEA WARRIOR Alignment*
- *Infrastructure Transformation – Distance Support*
- *Total Ship Training Architecture Standards*
- *SEAPRINT Implementation*
- *Virtual SYSCOM – FORCEnet*
- *Human Performance Lab Integration*
- *Next Generation Apertures, OA*

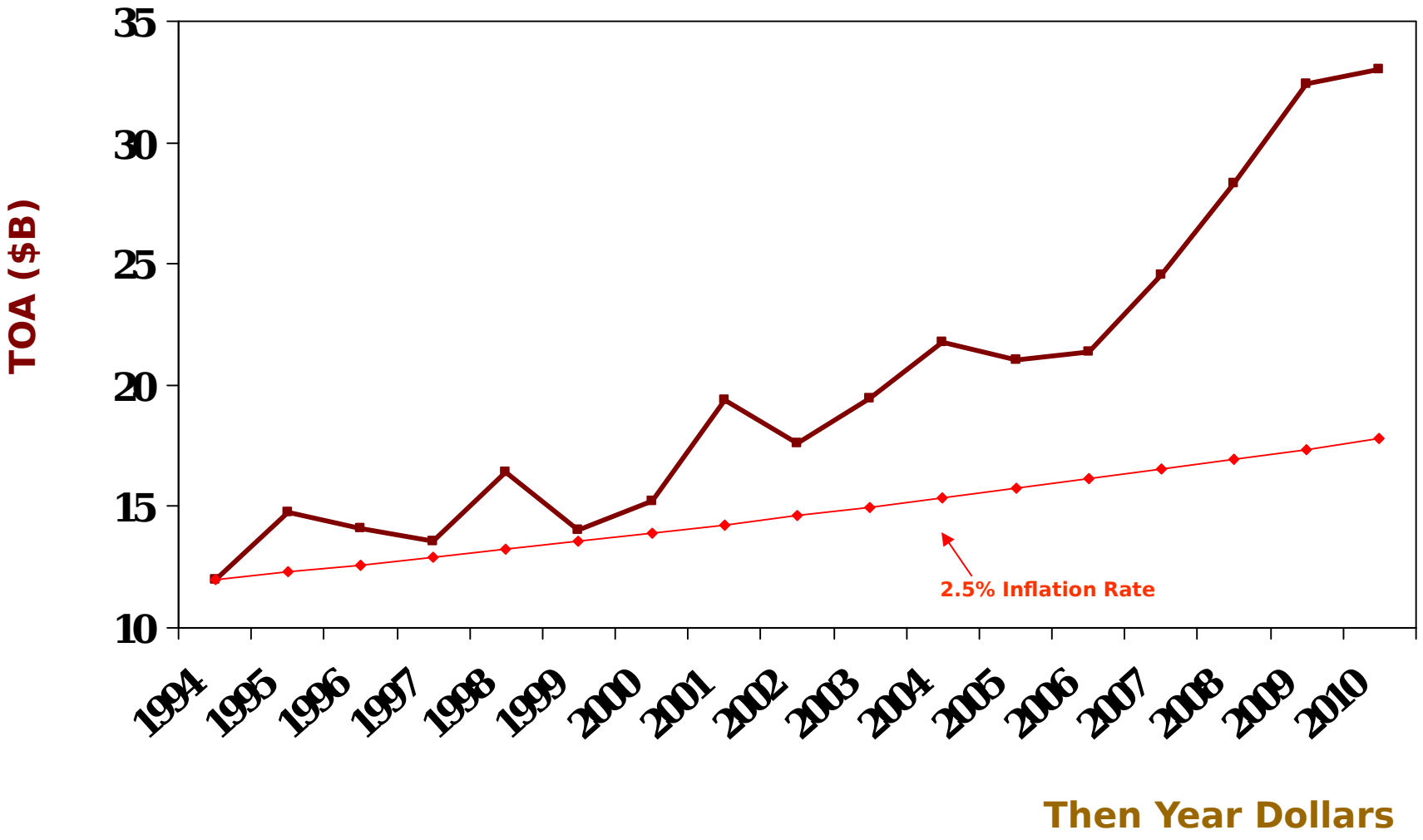
Designing / Building Navy For the Next 100 Years

Navy After Next

Last 10 Years	Next 10 Years
• *5-10 Concept & Feasibility Studies per Year*	• *30 – 40 Concept & Feasibility Studies per year*
• *DD 21 evolution to DDX*	• *High Speed Ships*
	• *Missile Defense Ships*
• *MARAD Studies*	• *Sea-Basing*
	• *Connectors*
• *Evolutionary Design Studies*	• *"The Next Generation Amphibious Ship may not have a well-deck, and will be air-capable"*
	• *Unmanned Vehicles*
	• *MPFF*
	– *Modular Payloads for Surface Ships & Submarines*
	– *Next-Generation SSN/SSBN/SSGN*
	– *Directed Energy / Electric Weapons*
• *Closed loop NAVSEA-PEO environment*	• *Future Naval Capabilities*
• *No tool development*	• *Virtual SYSCOM/Joint Arena Coordination*
	• *Seakeeping Tools*
	• *Hull form tools*
	• *High-speed ship tools*
• *Very little HSI – manning only*	• *Design/Requirements Trade-off tools*
	• *HSI involved at the beginning of the advanced concept phase*

Change the Navy With the "Speed-of-Heat"

NAVSEA TOA

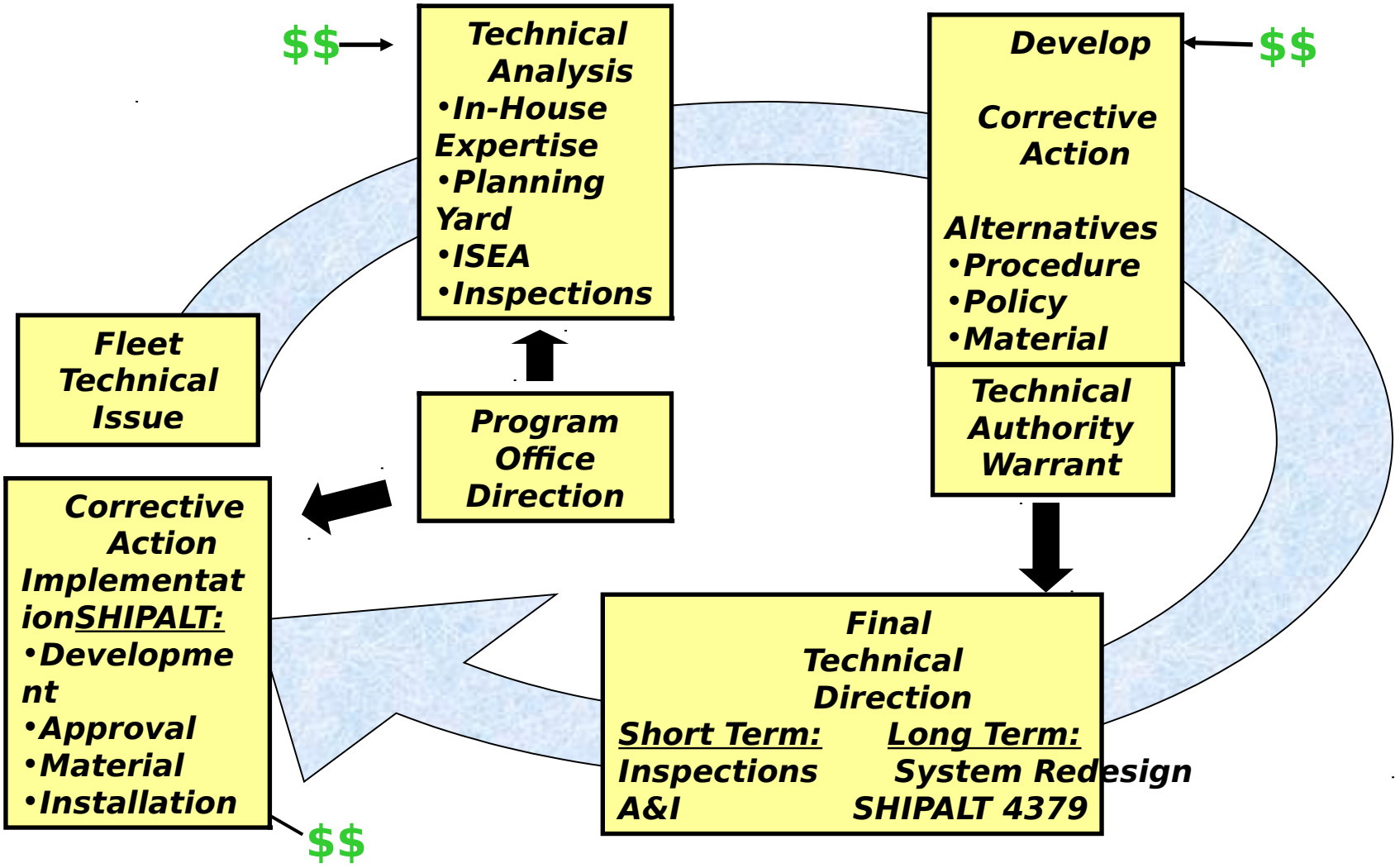


Then Year Dollars

Process

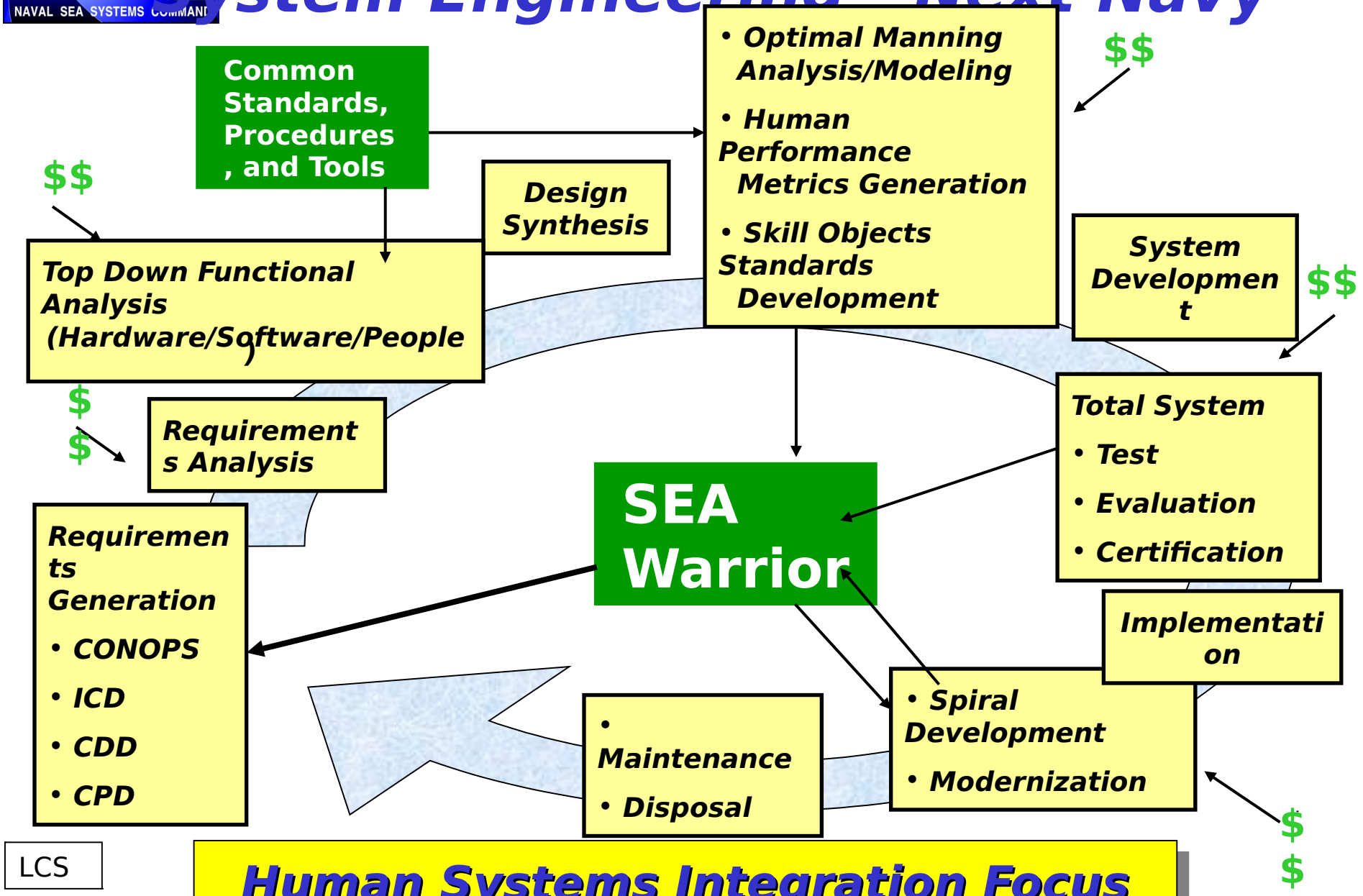
- What we do today
  - Current Navy
  - Next Navy
  - Navy After Next
- What we could do to optimize

Process
Technical Authority - Current Navy

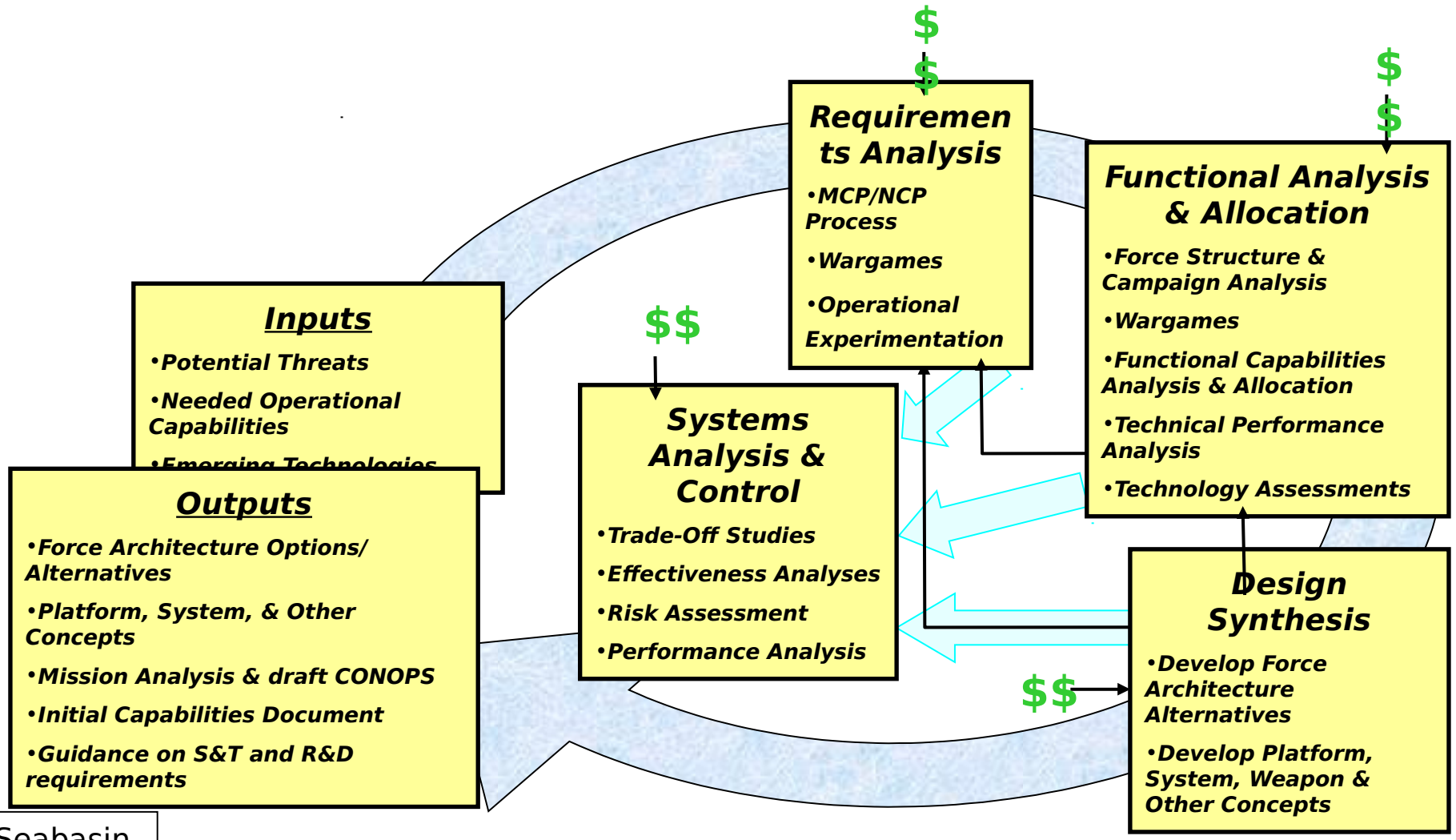


SEAWOLF Flow Restrictor

Process
System Engineering - Next Navy



System Engineering - Navy After Next

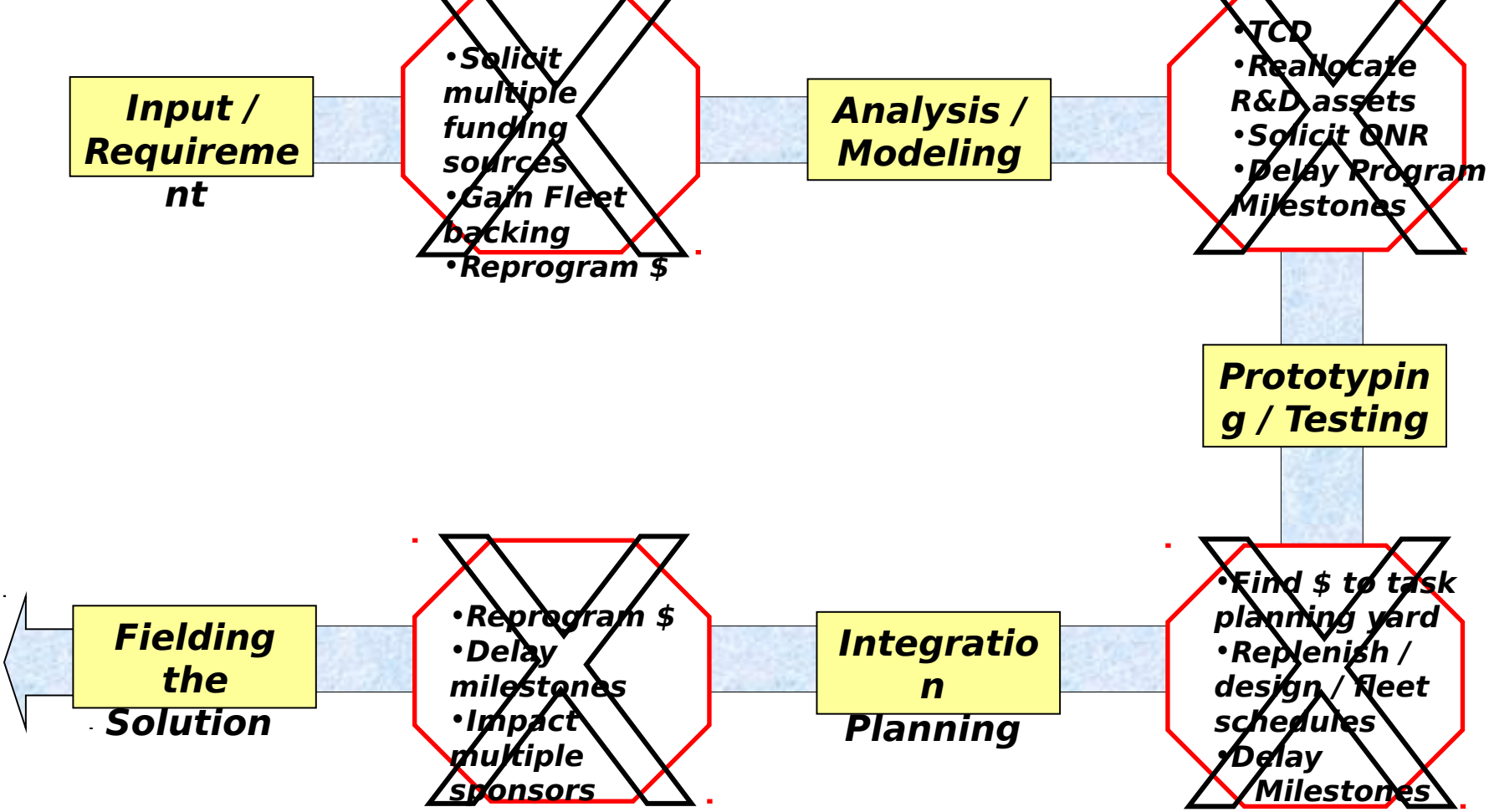


Seabasing

Support Warfare Requirements & Budgeting Processes with Credible Technical Concepts For Future Force, Platforms, Systems, Weapons & Networks

What are we really saying?

ecution path has unneeded institutional road blocks to efficienc



Optimize – Eliminate the Hurdles

Process Needs

- Competency
- Tools/Standards
- Numbers
- Strategy for what is government, what is contractor

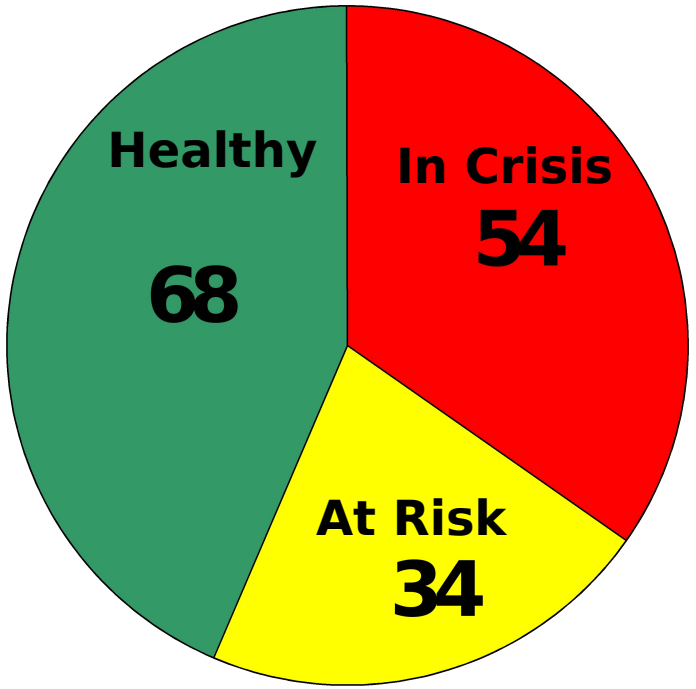
What is at Risk?

Healthy – Technical area has required capability, capacity and development pipeline.

At Risk – Technical area has required capability, but capacity or development pipeline is deficient.

In Crisis – Technical area does not have required capability, capacity and development pipeline.

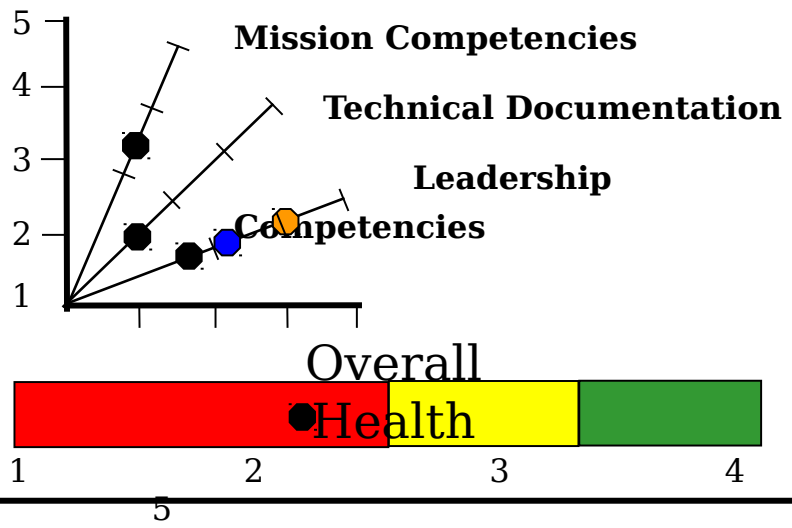
Health of the 156 Technical Focus Areas of Technical Authority and Systems Engineering



rsonnel Development Model → One-Deep in Some Areas

Dashboard – Underwater Explosion Shock

Long-Term Health Metrics



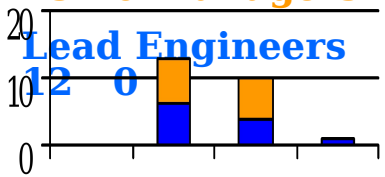
Demographics

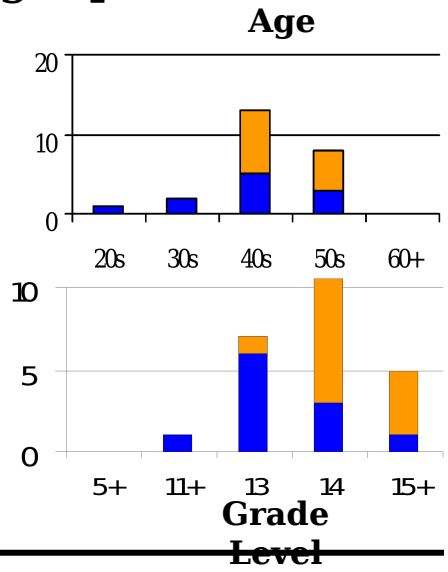
filled/vacant

Technical
0 1 Warrant Holder

Engineering
13 0 Managers

Lead Engineers
12 0





Actions to Improve Long-Term Health

Mission Competencies	**A. Develop Lead Engineers at Warfare Centers to support Program Offices.**
Technical Documentation	**B. Develop an improved sense of TEAM.** **A. Update current standards.** **C. Ensure consistency.** **B. Update current Instructions.** **C. Develop new Standards, Instructions, guidance documents, etc.**
Leadership Competencies	**A. Develop capability of Senior SME to be certified as TAE** **B. Develop a greater understanding of SEA 05's roles & responsibilities** **C. Develop an improved**

Sourcing Pyramid

SEA 00

SEA 05

SEA 05P3

Engineering Managers

Approximate Annual FTE:

288

Technical Focus Areas "In Crisis" (54)

Technical Areas	Cause	Trend
Afloat Medical Programs	Capacity, Pipeline	↑
Arrangements - Submarines	Capacity	→
Arrangements - Surface Ships	Capacity	→
Battleforce Systems Engineer	Capacity, Pipeline	→
Chief Systems Engineer for CVN 21 Class Warfare Systems	Capacity, Pipeline	↓
Chief Systems Engineer for Amphibious and Auxilliary Ships Warfare Systems	Capacity, Pipeline	→
Chief Systems Engineer for CV/CVN 68-77 Class Warfare Systems	Capacity, Pipeline	→
Chief Systems Engineer for DD(X) Class Warfare Systems	Capacity, Pipeline	→
Chief Systems Engineer for DDG 51/CG 47 Class Warfare Systems	Capacity, Pipeline	→
Chief Systems Engineer for LCS Class Warfare Systems	Capacity, Pipeline	↓
Combat Systems ISE for CG 47 Class	Capacity, Pipeline	↓
Combat Systems ISE for DDG 51 Class	Capacity, Pipeline	→
Damage Control, Firefighting, Recoverability, Personnel Protection	Capacity	↓
Deep Submergence System Scope of Certification (DSS SOC)	Capacity, Pipeline	→
Dry-docks	Capacity	↑
Force Level Warfare and Combat Systems Assessment (except undersea warfare)	Capacity, Pipeline	→
Machinery - Controls, Networks and Monitoring	Capacity	↑
Machinery - Fasteners	Capacity, Capability, Pipeline	↓

Technical Focus Areas "In Crisis" (54) *(cont'd)*

Technical Areas	Cause	Trend
Machinery - Integrated Submarine Hydraulic Systems and Components	Capacity	→
Machinery - Submarine Structural Closures & Hull Outfitting, Escape and Rescue and Special Warfare	Capacity	→
Machinery - Weapons Handling and Aviation Support	Capacity	→
Platform Certification	Capacity, Pipeline	→
Product Data Integration/Exchange	Capacity, Pipeline	→
Radar, IR, RF and EO Sensors (except Submarine Systems)	Capacity, Pipeline	→
Reliability Centered Maintenance	Capacity	↑
Reliability, Maintainability and Availability	Capability, Capacity, Pipeline	↓
Ship Design Manager for Advanced Submarines	Capacity	→
Ship Design Manager for Barges	Capability, Pipeline	→
Ship Design Manager for ONR Ship Programs	Capacity	→
Ship Design Manager for Combatant Craft, Boats and Marine Corps Vehicles	Capacity, Pipeline	↑
Ship Design Manager for Deep Submergence Systems	Capacity	↑
Ship Design Manager for In-Service Submarines	Capacity	↓
Ship Design Manager for LCU(R)	Capacity, Pipeline	→
Ship Design Manager for LHA(R)	Capacity, Pipeline	→
Ship Design Manager for Submarine Rescue, Diving and Recompression System (SRDRS)	Capacity, Pipeline	↑
Ship Design Manager for TAGM(R)	Capacity	↑

Technical Focus Areas "In Crisis" (54) *(cont'd)*

Technical Areas	Cause	Trend
Ship Survivability	Capacity	→
Shock	Capacity, Pipeline	→
Strike Force Certification	Capacity, Pipeline	→
Structural Integrity - Submarines	Capacity, Pipeline	↑
Submarine Level I Material and Identification (Non-nuclear) Control	Capacity, Pipeline	→
Submarine Safety (SUBSAFE) Program	Capacity	→
Surface Ship Certification (Total)	Capacity, Pipeline	↑
Surface Ship Combat and Weapons Control	Capacity, Pipeline	→
System Safety	Capacity, Capability, Pipeline	↓
Waterfront CHENG - FTSCLANT	Regional Alignment	↑
Waterfront CHENG - FTSCPAC	Regional Alignment	↑
Waterfront CHENG - SUPSHIP Groton	Efficiency	↑
Waterfront CHENG - SUPSHIP Gulf Coast	Efficiency	↑
Waterfront CHENG - SUPSHIP Jacksonville	Regional Alignment	↑
Waterfront CHENG - SUPSHIP Newport News	Efficiency	↑
Waterfront CHENG - SUPSHIP Portsmouth	Regional Alignment	↑
Waterfront CHENG - SUPSHIP San Diego	Regional Alignment	↑
Weight Control and Stability	Capacity, Pipeline	↑

We are *in extremis.*

Funding levels do not support the NAVSEA's statutory requirement for executing technical authority. Present manning policy further complicates the situation.

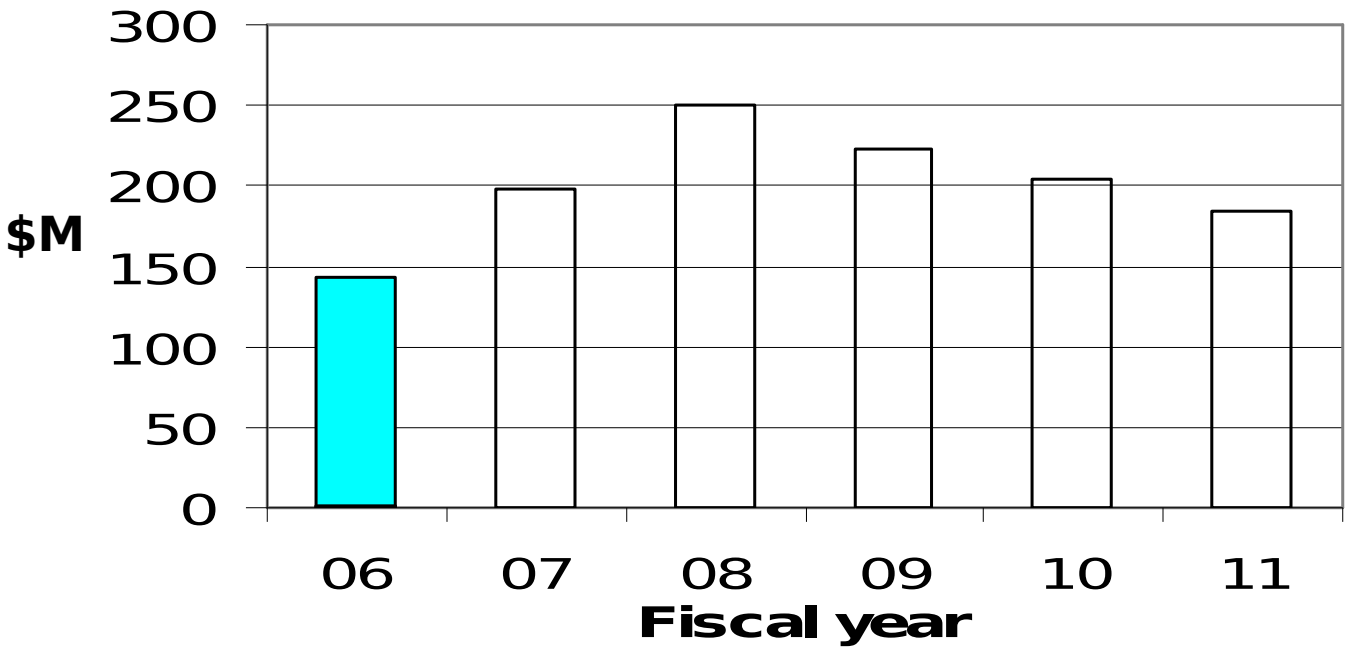
CNO 2004 Guidance

"Examine the organizational options for technical authority…"

Resources

- What did we submit last fall?
- What did we submit this spring?
- What is and is not included?

FYDP Resource Submit Fall 2003



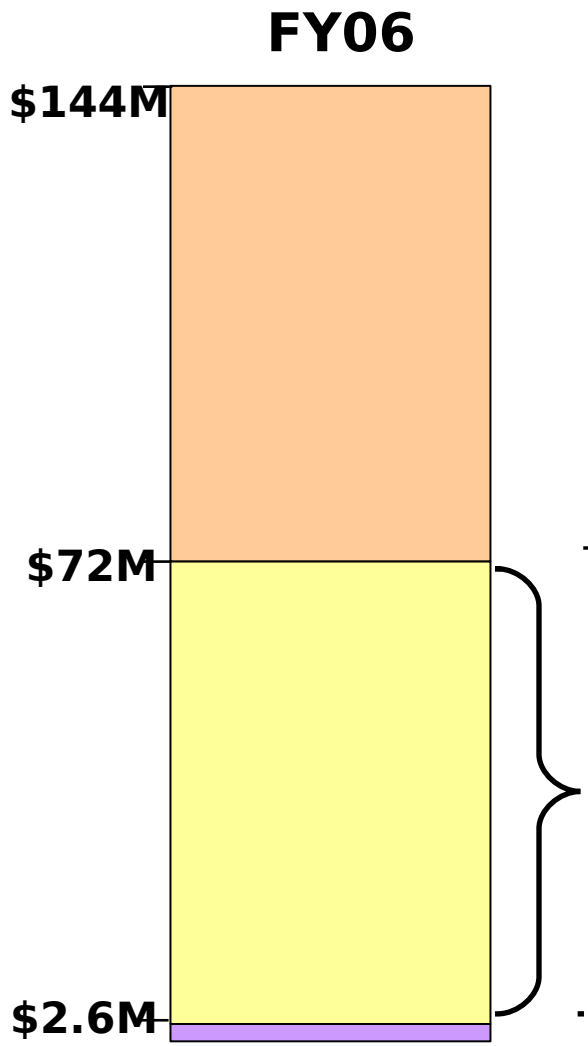
Fall 2003 Submit To Team Surface

Product Line Approach

As feedback developed

NAVSEA Corporate Approach

Resource Submit – Round Two

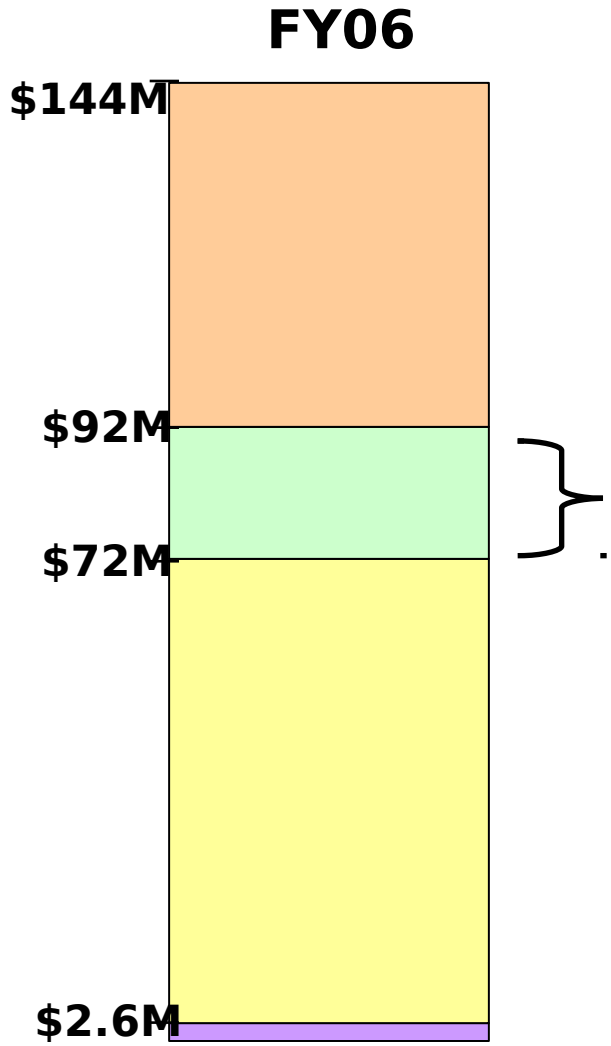


Risk assessment of balance between fiscal realities and setting foundation

Increment One – Baseline Submit

- HSI – certification criteria / program baselines
- Revitalize Technical Standards and Design Tools
- Future Force Ship Concepts and Ship Concept Design Tools
- Stand up Interoperability evaluation and test process
- Start engineering at the Force Architecture Level
- Develop / maintain Fly-by-wire ship control program, ensure fleet support of VA Class

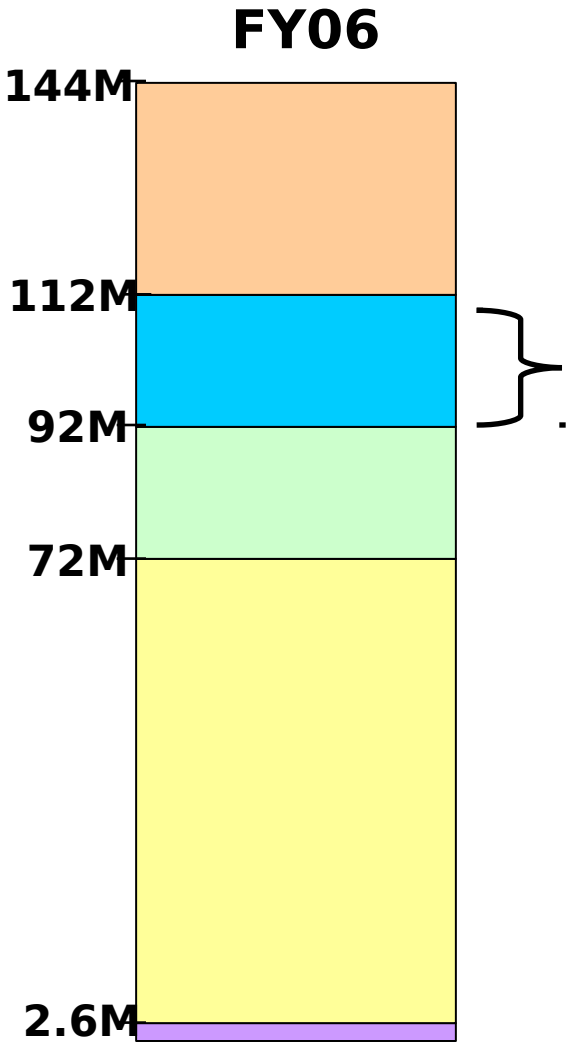
Resource Picture – What is the right level?



+$20M – Increment Two

- HSI – Optimal Manning Experiment implementation
- Human Performance Lab integration
- Mission System/Ship Integration Standards and Processes
- Total Ship Certification
- Future Force Formulation & Future Force Architecture for N70
- Migrate S&T Technologies into transition to Warfare Systems
- Cross-Platform Submarine Technical issues studies / SUBMEPP Maintenance Studies

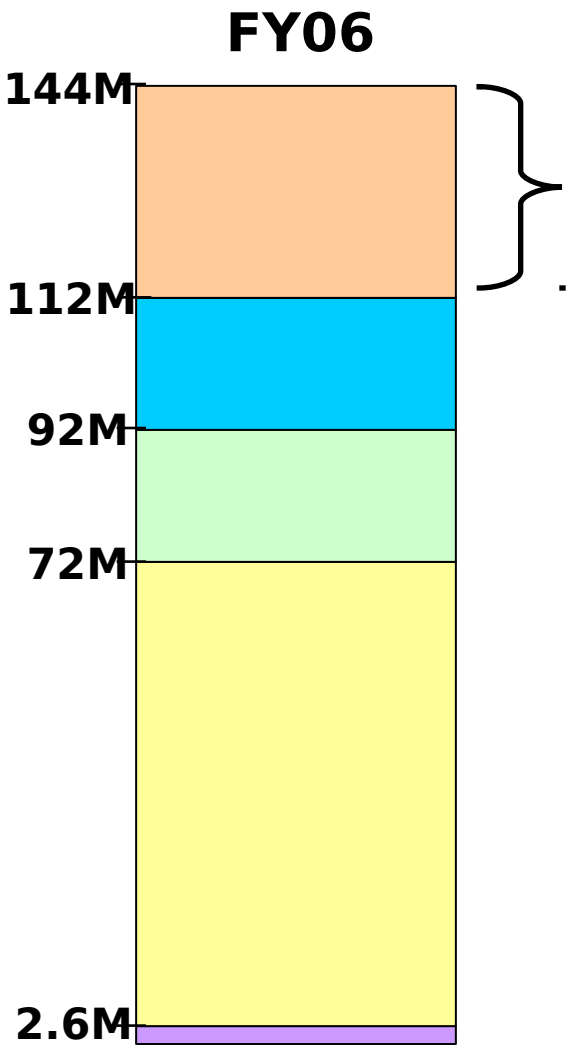
Resource Picture – What is the right level?



+$40M – Increment Three

- Joint HSI Requirements
- FNCs and Surftech HSI assessment
- Tools for new technology insertion into ships
- Implement net-ready KPP compliance for JCIDs systems IAW CJCS instruction 6212.01C
- Analysis of future warfare architecture to guide S&T community
- Higher order aggregate review of submarine deficiencies

Resource Picture



Increment Four

- Topside design integration tool and process
- Naval Network Integration
- Advanced propulsor / hull design tools
- Advanced mission modules / launcher integration studies
- Comprehensive warfare technology analysis, evaluation, and transition into shipboard systems

DEP – Since We Last Saw You CFFC 032037Z May 04 C5IMP Policy

A Fleet Mandate:

TECHNICAL AUTHORITY:

- **"Assess C5I modernization capability improvements, technical readiness, system safety, and interoperability . . . . ."**
- **". . .all . . .integration testing must be satisfactorily completed prior to installing . . . ."**

SYSTEMS ENGINEERING:

- **"Lead effort to certify Alteration, Integration, and Total Ship Performance for applicable systems."**
- **"Fleet Commanders will only approve alterations that have been accredited by the SUBMOD/SHIPMAIN process."**

HUMAN SYSTEMS INTEGRATION:

- **" NAVSEA 03 lead development of Joint SYSCOM HSI Certification of C5I Modernization Systems."**

AND INTEROPERABILITY:

- **"Assess C5I modernization capability improvements, technical readiness, system safety, and interoperability . . . . ."**

DEP – Since We Last Saw You

- **CFFC 032037Z May 04 – Subj: C5IMP Policy**
  - **Fleet mandate: "Certify platforms to ensure interoperability within the platform and Strike Groups using the Distributed Engineering Plant (DEP) and Combat Systems Integration Testing (CSIT) Programs."**

"The DEP, managed by NAVSEA 06, will test and certify selected…C5I Software Capability/interoperability for Strike Groups (including multiple Strike Groups) Operating with Joint and Coalition forces."

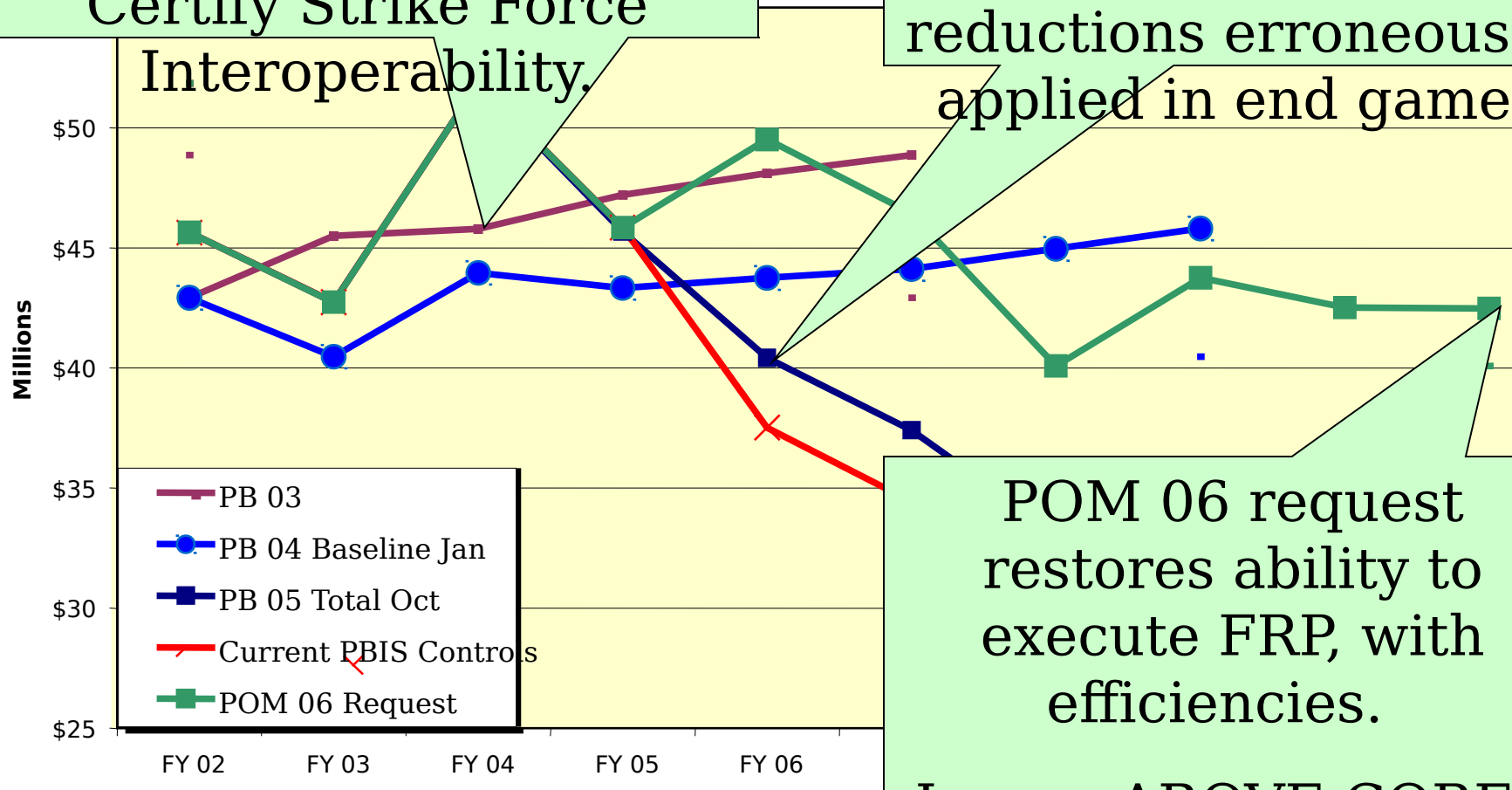
	FY06	FY07	FY08	FY09	FY10	FY11
PB 05 – DEP	**$6M**	**$5M**	**$4.2M**	**$5M**	**$5.5M**	**$5.5M**
Request-DEP	**$12M**	**$12M**	**$10M**	**$13.5M**	**$11.5M**	**$11.5M**
SPP - DEP	**$18M**	**$17M**	**$14.2M**	**$18.5M**	**$17M**	**$17M**

- Restoration of POM 04 cut is critical to retaining ability to certify C5I Modernization.
- Certification approach aligned to FRP evaluates all increasing system complexity within cost.
- 400 vice 120 platforms will receive FIT testing and CAPS/LIMS documents.
- Preserves the Navy's only Net-Centric Test Bed.

Strike Force Interoperability Program History - DEP

Program of Record established at Minimum Level to Operate DEP and Certify Strike Force Interoperability.

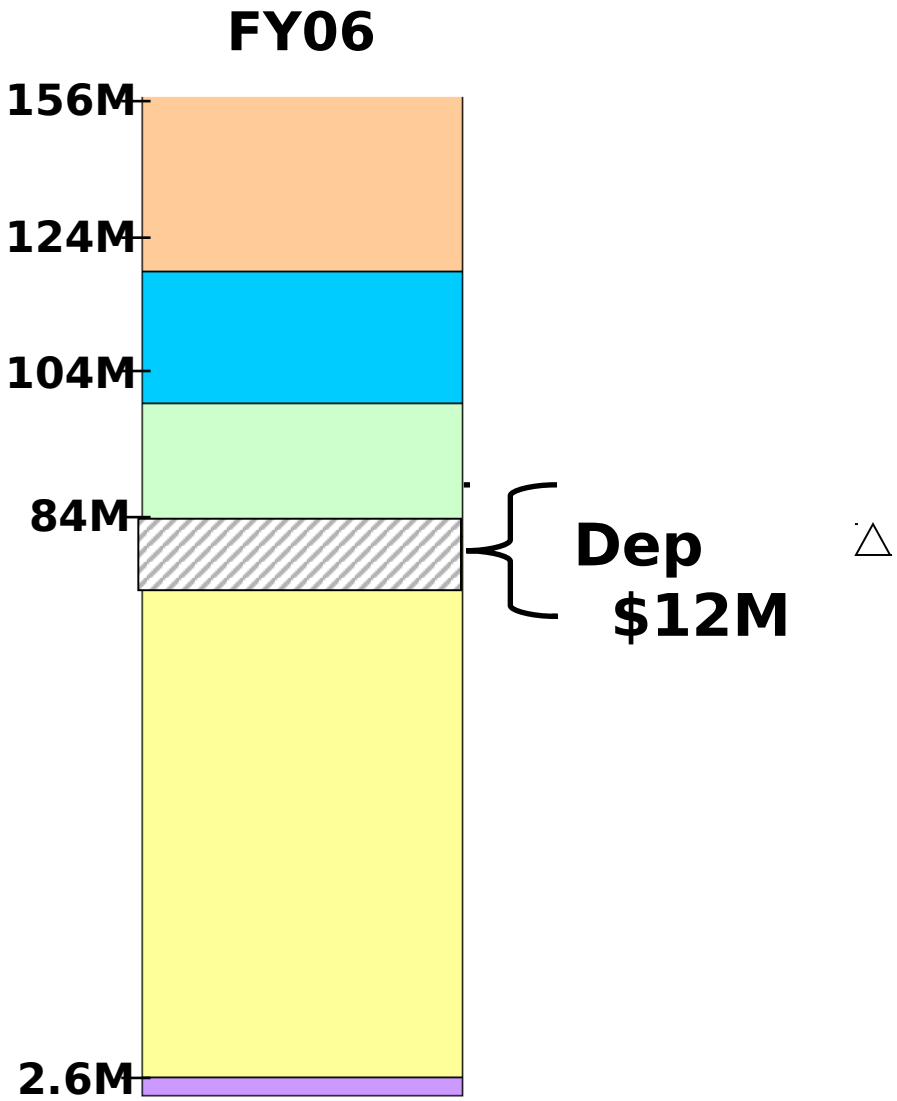
Issue: Post POM-04 baseline unexecutable as a result of reductions erroneously applied in end game.



POM 06 request restores ability to execute FRP, with efficiencies.

Issue: ABOVE CORE.

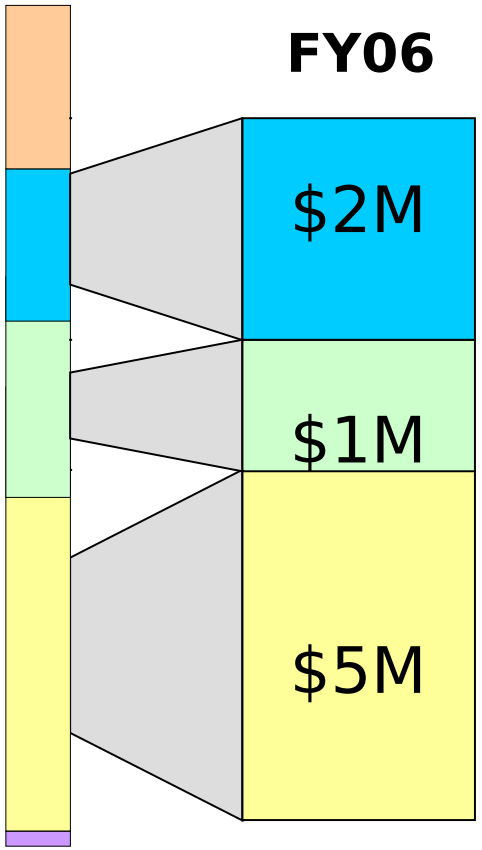
Result: Rebaselined Request



Our Request Serves 6 “Business Lines”

- Human Systems Integration
- Certification
- Future Fleet Capabilities
- Mission Capability Systems Engineering
- Embedded Interoperability Engineering
- In-service Submarine Systems Engineering

Human Systems Integration



Increment Four

- None

Increment Three

- Joint HSI Requirements – Navy After Next
- Future Naval Capabilities, SURFTECH – Navy After Next

Increment Two

- Expanded Optimal Manning Experiment -Large Deck Amphibs / Carriers – Next Navy
- Navy-wide Human Performance Lab integration – Next Navy

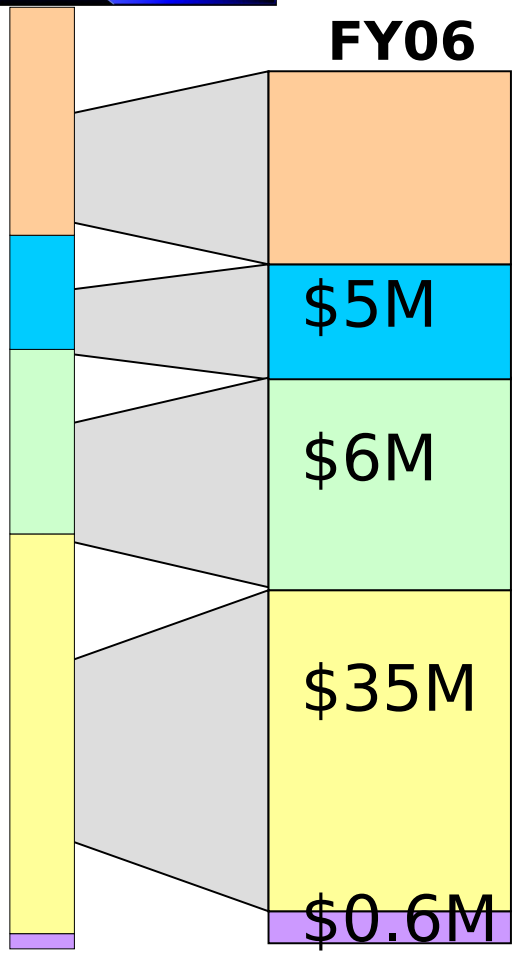
POM 06 Submit – Increment One

- Optimal Manning Certification
- Human Performance Metrics/Test Procedures
- Sea Warrior Alignment (Process/Tools)
- Shipmain → Modernization
- FRP C5I – HSI Certification
- SEAPRINT Implementation/Standardization
- Fleet Training Performance Assessment
- Total Ship Training Architecture Standards
- Virtual SYSCOM Common Practices

PEO Funds

- Smart Ship
  - –Workload Reduction Technologies
- DD(X)
  - –Top Down Functional Analysis
  - –Platform Specific Sailor Performance Specifications
- DDG 51 Modernization --- Reduced Manning Study

Certification



Increment Four
- Ship Propulsor Design Integration Tools
- Stand-up Naval Network Integration Process
- Integrated Topside Design Process and Tools

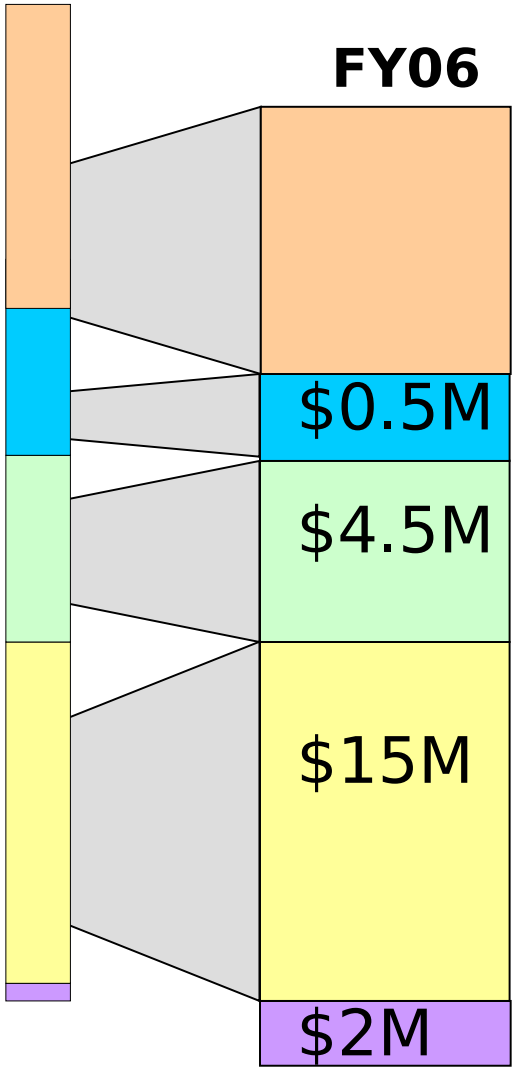
Increment Three
- Advanced Hull Design Loads Modeling

Increment Two
- Total Ship Certification Process
- Technical Standards – bring to baseline
- Mission Systems integration interface standards & processes

POM 06 Submit – Increment One
- Initiate Technical Standards Update
- Ship Certification Tools
- Maintain Submarine Hull Assurance & Safety
- Hydrodynamic Technology/Systems Integration
- High Speed Ships and Crafts – Tools, processes & Criteria
- Ship Hardening Program – Shock

PEO Funds
- Shock Qualification Adherence for programs
- Design Review and change proposals for programs
- Selected ABS collaboration

Future Fleet Capabilities



Increment Four

- Modular Payload SSN / SSGN
- Open transfer Systems Interfaces
- Modular Missile Launcher Concept
- Specialized Mission Modules for Small Surface Combatants
- Advanced Machinery & Auxiliary Systems for high speed, low signature, optimal manned Navy

Increment Three

- Small Ship C4I Architecture

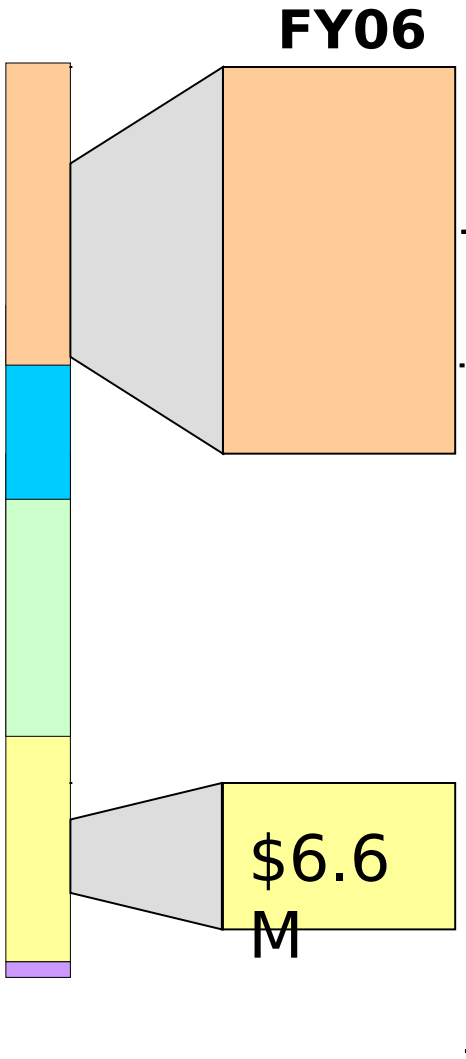
Increment Two

- Advanced Surface Ship Development Efforts
- Future Force Formulation, Force Architecture & Fleet Concept Design Synthesis & Analysis for N70
- Comparative Naval Architecture

POM 06 Submit – Increment One

- Center for innovation in Ship Design
  - Processes & Tools for innovation
- Ship Concepts & Surface Ship Advanced Development
  - Sea Basing/Strike/Shield Ship Concepts
- Submarine Design Concepts
- Next generation USV

Mission Capability Systems Engineering



Increment Four

- More rigorous analysis to project future capability requirements to enable revolutionary vs. evolutionary S&T
- Improve Technology Transition Management and Opportunities
- S&T Migration Roadmaps
- Infrastructure support for Tech Authority Pyramids

Increment Three

- None

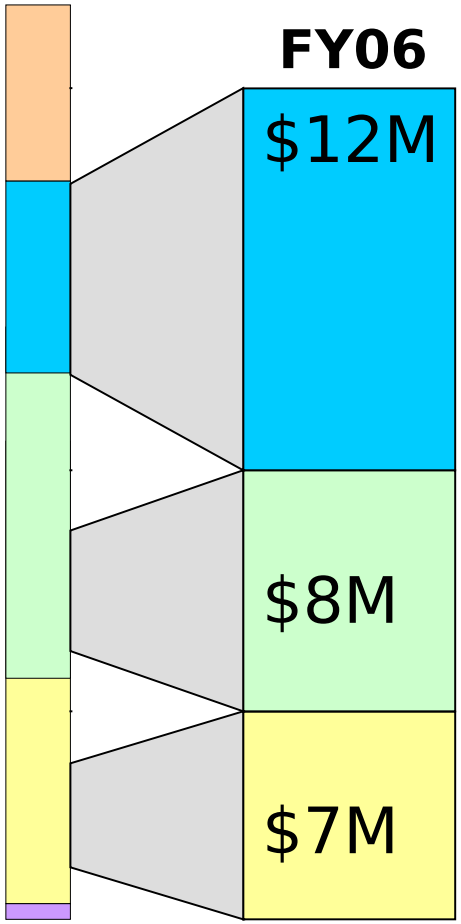
Increment Two

- None

POM 06 Submit – Increment One

- Engineering at the Systems of Systems / Family of Systems (SoS/FoS) Level
- Executing a Disciplined Warfare Systems Engineering Process
- Developing Architectures that enable us to engineer FoS / SoSs
- Using Architectures to conduct more affordable AoAs
- Document / Review mission capability based requirements

Embedded Interoperability Engineering



Increment Four

- None

Increment Three

- Per CJCS Inst. 6212.01C, establish Navy's implementation process for validation of the Net-Ready Key Performance Parameter compliance for JCIDS systems

Increment Two

- Force level evaluation of Prototype/SEA Trial Insertion
- Influence system design by integrating certification criteria early in requirements definition
- Integration electromagnetic control and Spectrum Management Technical Authority Implementations Pyramids

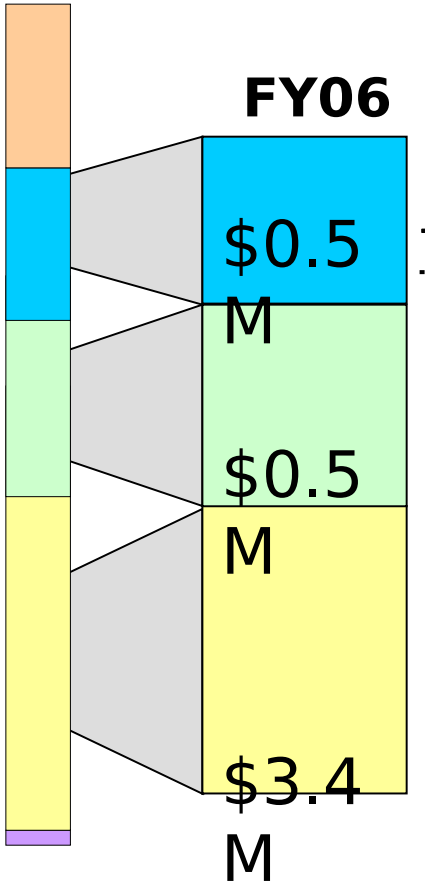
POM 06 Submit – Increment One

- Evaluating systems early in the development cycle
- Maximizing functionally of integrated systems
- Ensuring major test plan elements across all systems that comprise a "major capability" are integrated and maximize common practices
- Ensure COTF, Safety, and training / HSI elements are integrated

PEO Funds

- System Development Testing
- Limited System Integration Testing (combat system not platform)

In-Service Submarine Systems Engineering



Increment Four

- None

Increment Three

- Higher order aggregate review of failure data, trend analysis

Increment Two

- Detailed cross program and platform review
- SUBMEPP maintenance studies

POM 06 Submit – Increment One

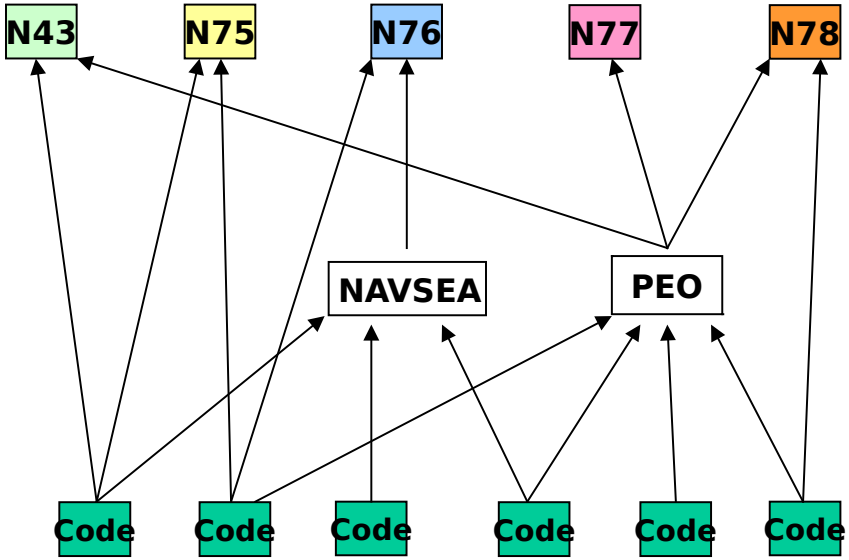
- Technical support to VA class electrical systems, SSGN VLS, Fly-by-Wire ship control certification
- Subsafe and deep submergence certification program
- Maintenance of technical documentation (Level 1 boundary book, subsafe design review manual, fly-by-wire requirements manual, subsafe manual technical requirements)

PEO Funds

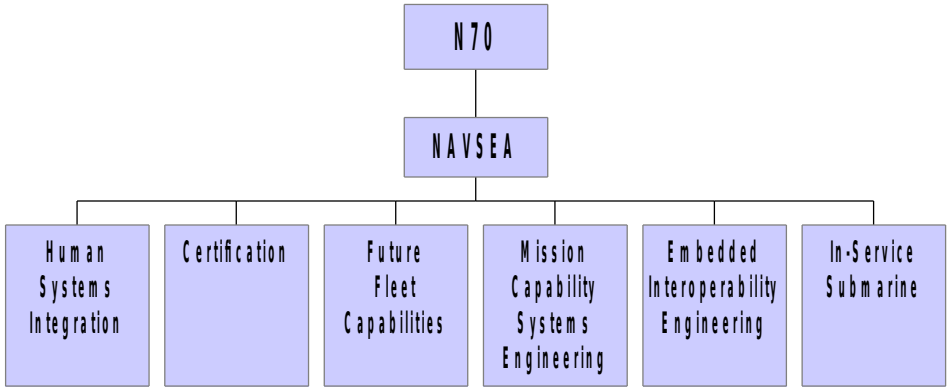
- SUBSAFE Certification Process for assigned ships

There is more we can do

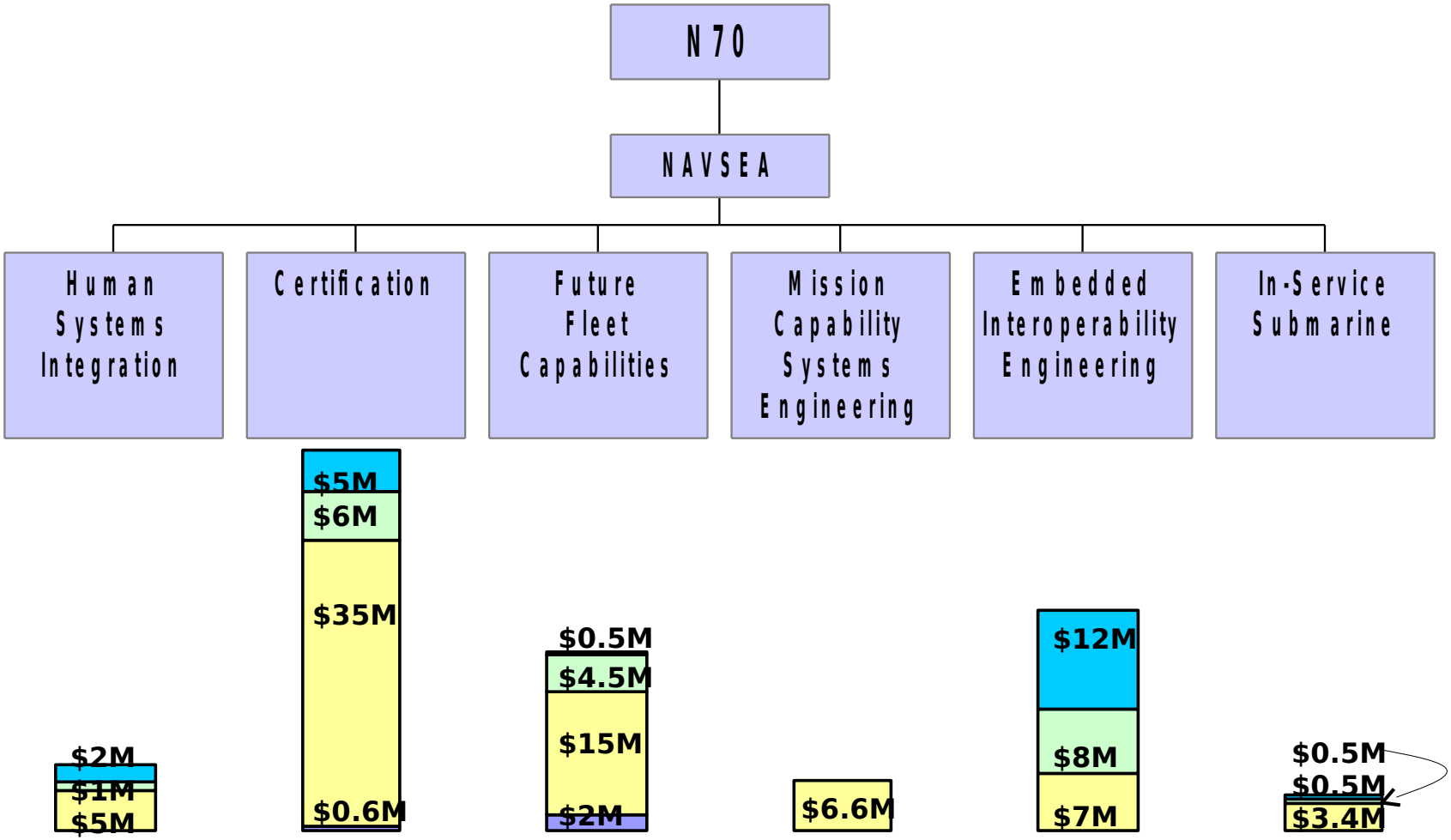
Today's Resourcing Process



A Different Approach...



A Different Approach



Take Aways

- Statutory responsibility
- Mandates optimum corporate process
- Funded at the appropriate level